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ABSTRACT

This speech was prepared for the National Conference on Metrication which was planned for April 1977 (but cancelled). In it the author observes that it is necessary to be clear about which of the several versions of the metric system is being adopted. He cites the relationship between the metric system and decimal numeration, and calls to task those who try to think in terms of halves, quarters, and eighths of metric units. He discusses selected aspects of conversion to the metric system in England, Canada, and South Africa. He concludes the paper with discussions of five conditions he finds inextricably related to successful conversion to the metric system: freedom, voluntarism, concensus, leadership, and cost. (SD)

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THIS I WOULD TELL AMERICANS AT THIS STAGE OF THEIR METRIC COMMITMENT

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A Paper Prepared
in Connection with a Proposed
National Conference on Metrication
April 1977

- -

by

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Professor of Education
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THIS I WOULD TELL AMERICANS AT THIS STAGE OF THEIR METRIC COMMITMENT

A Paper Prepared
in Connection with a Proposed
National Conference on Metrication[1]
Arlington, Virginia
April 1977

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Leafing through the education pages of a Sunday New York Times the other day, I was struck by the proliferation of ads for cram courses for the SAT, the GRE, and other alphabet-age academic hurdles for which, whatever else, one is not supposed to be able to cram. My reflections took me back, quite agreeably, to my own days of pursuing graduate studies in your country . . . when, at one point, I had to convince immigration officials that I could indeed speak and function in English; and a university hierarchy that I could, among other feats, drop the proper names in the proper slots in professional edu-

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[1]Prepared as a keynote address for a national conference which was to have been sponsored by the College of Education and Extension Division, Virginia Polytechnic Institute and State University, and held at the Howard Johnson's Motor Lodge, Washington National Airport, Arlington, Va. The conference was not held; the undelivered text, however, may prove of interest to some who might have attended and to others attracted by the challenge of "a metric America."

cation. In this latter connection, which involved the GRE, Psychology, somehow, had seemed the most intimidating of areas. The prospect of properly associating names, concepts, special terms, and such, in prescribed, rapid-fire, multiple-choice fashion, was less than reassuring to an unorthodox but eclectic mathematics educator whose heros included Hall and Knight, the Wentworths, Mauritz Escher, Georgys Polya, and Ernest Ranucci . . . none of whom was particularly likely to be on the test. Accordingly, one long Spring evening found me at a subterranian level in the university library digging into the stacks labelled Psychology. I had the names, you understand. What I wanted was the proper associations. I looked to the first name (now mercifully forgotten) . . . and found nothing (nothing!) on the shelves. He wasn't there as author. He wasn't in indexes. The second name . . . the same story. It was a bad dream . . . a nightmare . . . except for the very real, musty odour of three million volumes. The "morning after" found me awaiting my doctoral advisor as he arrived at his office.

"Where were you looking?" he asked, reasonably.

"Psychology!"

"Oh, no! They're, every one of them, Educational Psychologists."

And, you know, that's where they were . . . under Education . . . Educational Psychology.

Complicated world, isn't it?

Years later--in fact, not so long ago--I chanced upon another, quite similar complication. In this age of CB jargon, where five watts carries the message and the "handle's" the thing, the very real demands of a good amateur license still separate the men from the boys.[2] Accordingly, thinking I'd like to do some reading in the field, and perhaps someday submit myself to Canada's rather formidable amateur examinations, I picked up a presentable introductory paperback on related theory and practice.[3] I sat down to see what I could make of it. Now, my Physical Science background is respectable. My international metric certainly is more up-to-date than might be the case for many of those with whom I studied Physics and Chemistry twenty-five years ago at McGill. (It has to be: I'm a teacher.) But I soon ran into rather perplexing idiosyncrasies. The author wrote of mills (or mils). It turned out it was "milliamps" . . . more correctly, milliamperes.[4] He talked megs. Megohms? No, megacycles . . . more strictly, megacycles per second, or megahertz.[5] A different language, or at least dialect . . . though, of certainty, a

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[2]Eavesdropping on 10-35s, 10-57s, 10-89s, and such, carried to excess, one suspects, might make a 10-96 of us all. See, if prone to such indulgence, the APSCO 10-code, Communications World, Spring-Summer 1977, p. 31.

[3]Morton Biback [VE3CSE], Ham Handbook for Beginners (Don Mills, Ont.: Arta Publishing Co., 1972).

[4]Ibid., p. 3. [5]Ibid., p. 19.

great commonality of shared ideas, idiomatically expressed.

We've hinted at two instances of this sort of thing:

The psychologist . . . and the "educational psychologist."

The physics instructor . . . and the radio "ham," cultivating his own brand of jargon.

As I expand my horizons, and all of us must, it's not iniation into a succession of secret societies that I seek, but opportunity to broaden my base of communication, as learner and as teacher. The approach of a medieval guild is, I submit, poorly suited to this, a space age.

You suspect, about at this point, that I should urge that we all speak "metric"--and, in measurement matters at least, be able fully to understand one another. That's a sound suggestion, but as you know, it's not all that simple. There are many varieties of metric. It would be most surprising if there weren't, after nearly two hundred years of practical evolution. Scientific American, to me required reading, is (of course) essentially metric--such is the nature of the world of science. It is also a latter-day Tower of Babel . . . in the angstroms, the parsecs, the light years, and other measurement units, concepts and practices, distinctive unto (and cherished by) certain scientific branches and applications. We need, therefore, to be abundantly clear as to what brand of "metric" the world is moving to, and why . . . and the clear-

cut advantages which it can afford as an international measurement language. Lacking this perception, you will, I fear, opt for shortcuts, here an old term, there a compromise . . . and you'll shortchange America, and very possibly shortchange posterity.

Modern metric, you realize, is world property . . . not a French possession, nor the scientists' prerogative, but an evolved, negotiated international system of "weights and measures," for all trades, all purposes, a true reflection of the "state of the art" in measurement science . . . and a structure designed to remain responsive to future technological development and as yet unimagined measurement needs.

International metric, the so-called Système International d'Unites (or SI), is understood to be the substantial revision of 1960, as negotiated at that year's General Conference on Weights and Measures. United States commitment is to that system, with (I gather) recognition of significant subsequent developments--for example, establishment of the pascal unit for pressure. This is not, you realize, the CGS, MKS, or MKSA versions of metric taught some years ago--or found in many textbooks in the physical sciences to this day.[6] Most of us live our lives, both private and vocational, without all that much need for measurement theory . . . but those who most use measurement,

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[6]Initials refer to base units in terms of which the respective systems were structured--centimetre-gram-second, metre-kilogram-second, and metre-kilogram-second-ampere.

be they American or European, technician or farmworker, may, in truth, have much to relearn.

Let me, then, say this: "metric" is Système International of 1960--SI.

Of the essential characteristics of SI (the decimal structure, the uniqueness and coherence of units, the non-gravitational basis of definitions), one--very possibly the simplest--is to be of greatest significance for the effective introduction of the system in all walks of life. Simplest to understand, I would think, and yet perhaps the most difficult to appreciate in all its implications, is the tens structure--the fact that SI (indeed, all metric) measures in tens--just as we count in tens, and for that very reason. Multiples of SI units ten, one hundred, one thousand, one million, . . ., times basic units. Submultiples (and this tends to be where we balk!) are one tenth, one one-hundredth, one one-thousandth, one one-millionth, . . .--that is, decimal subdivisions of the basic unit. So, what's hard? Nothing, for a child! . . . the whole process beautifully reinforces basic lessons on number and numeration. Everything for us! . . . the need to unlearn the fundamental practice of halving, quartering, and such, in measurement with old units. The need, too, to give up the unarticulated belief that eights, sixteenths, or certainly sixty-fourths, ever were exact . . . and to appreciate approximation, precision and accuracy in measurement, significant digits--topics that have been treated superficially or ignored in traditional teaching (outside the

shops!), but which are essential to true understanding of decimal measures. Children pick this up easily (once their teachers do), but there's a pedagogical truism about an old dog and new tricks!

Don't think I exaggerate! The English, always quick with a learning aid, have marketed a decimetre cube . . . halved, quartered, and eighthed, to teach such concepts as <u>one-eighth of a litre</u>. Used in reverse, it might have possibilities for showing that 2x, quantity cubed, is $8x^3$ . . . but as a metric aid, it's something else! Canada, after due deliberation, has evolved a particularly grotesque module in which to market milk . . . four litres, in a pack of three plastic bags. Both our countries, in their wisdom, have approved a 187 millilitre wine or liquor fill. Three significant digits, allegedly . . . but you don't fill a bottle with that kind of precision. Do you recognize the number? Half-way between one-eighth and one-quarter, 187 millilitres is <u>three-sixteenths of a litre</u>, rounded down! Decimal thinking? Toothpaste tubes, 25, 50, 100, and 150 millilitres, are not bad, and that's all that's on the market in our town. Five hundred grams icing sugar, one or two kilograms of sugar, five or ten kilograms of flour, all sound sensible. I believe we're to have a 300 millilitre soft drink can. I like that--the size is really given by one digit. Now, a 454 gram box of chocolates doesn't bother me. It's not really pretending to be "converted," and its day will come. Two hundred twenty-five grams of potato chips <u>does</u>. It's <u>thought</u> to be "metric,"

and nine-fortieths of a kilogram is hardly the metric sizing I'd choose to see.

In this admittedly complex area, a less-than-optimal decision can, on occasion, have rather far-reaching repercussions. For example, a somewhat awkward measuring cup (and I fear we're to have one) can diminish the advantages of decimal measures in . . . how many million kitchens? "Metric" kitchens in North America will still, by and large, measure out ingredients by volume, rather than weigh them. (To "go metric" isn't necessarily to go European, you understand.) The "metric" measuring cup is to be 250 millilitres . . . the teaspoon, five millilitres; the tablespoon, fifteen. Now, whether you want to "metricate" old recipes, subdivide portions, or what, with the 250 millilitre cup, you're quickly up against numbers like 62. There are very practical problems. A 200 millilitre cup, subdivided to twenties or tens, would have been preferable . . . it beautifully reinforces tens thinking . . . but, perhaps, a bit smaller than we've been used to.[7] The 15 millilitre tablespoon and 5 millilitre teaspoon I find interesting to reflect upon. The Bahamas, in their wisdom, currently have a squarish 15 cent piece. Not really fitting in with decimal money circulation, it spends (I gather) most of its time at the bank. The Soviets have a 15 kopeck. I

[7]Traditionally, the eight-ounce measuring cup was 227 millilitres for Canadians (based upon the Imperial fluid ounce); 236 millilitres for Americans. Few kitchen practitioners were aware of the distinction, one suspects.

really don't know its role. One-two-five-ten-twenty-fifty, the sequence of banknote denominations, is particularly good as a "decimal" sequence. You'll frequently encounter it in weights for metric scales. So much for metric kitchens and 250 millilitre cups. There's little point in crying over spilt milk, to mix a metaphor, but we'd do well to speak up for decimal structure when other decisions of this sort are being taken.

Consideration of accuracy, precision, and rounding of measurement-derived data gives rise to some rather novel questions. One-third of a yard is a foot. What meaning should we give to one-third of a metre? (I know that metre is decimal, but we still can divide it into three equal parts.) Well, the assigned meaning will have to be determined by the context. In dressmaking, where the centimetre is the appropriate unit, one-third of a metre might best be called 33 centimetres. The machine shop would prefer 333 millimetres. Each is a decimal approximation. But then, every metric measurement, properly stated, is just that, a decimal approximation. For many of us, this will represent a whole new approach to measurement thinking, but it does have advantages. As for something being exactly one yard long, and one-third of it being exactly one foot, it never was that simple, you know!

Three significant strands of metric thought, here, are (necessarily) inextricably intertwined. Let me, in summary, say as follows:

Metric is decimal . . . as, for us, is numeration itself.

Thinking in tens leads to preferred groupings . . . and to logical subdivisions. Ideally, these numbers will be reflected increasingly in many aspects of our lives.

Measurement, essentially, is a process of approximation. The elegance of decimal representation focuses sharply on the process and nature of such approximation.

Now, let's get to the real issue!

There comes to mind a cartoon I've always liked. The old bishop is guiding the young clergyman as to pitfalls to avoid in dealings with parishioners. Steer clear, he says, of three topics: sex, religion, and politics. Two out of three isn't bad . . . but politics are at the heart of what we're here to talk about.

Metric conversion, you understand, is too important to leave to the politicians. Its far too important to leave to us educators! So, let's sort out the words and the ideas . . . freedom, voluntarism, consensus, leadership, cost . . . and trust that everyone who wants to will have a hand in getting on with the job.

Freedom, as might be expected, comes through as the most central of ideas. To some, it's freedom to "do one's thing" in measurement matters . . . be that in bushels and pecks, rods and furlongs, or agate lines . . . freedom from regulation, from outside influence, from government control. I sympathize, believe me, with such a viewpoint. However,

I see far greater freedom in the contrived simplicity and attainable universality of metric standards and truly decimal practices in measurement. I'm not talking "one world"--not really. For the immediate future, that may be utopian. When an American says, "I don't have to care if they're 'going metric' in Belize or the Cayman Islands," he has a point. I've been to both places recently, and critically looked at their economies.[8] The American doesn't have to care. However, the European Economic Community (the "Common Market") is quite another matter . . . so are Canada, Mexico, Japan, Australia, New Zealand. No exporting nation can wholly ignore its customers' professed preferences, I suspect![9] If you really feel, "We make them . . . they'll buy them," I'm afraid you're deluded. To cite one instance, try to sell an American school textbook that fails to conform to preferred international standards in Canada today! However, America's "multinationals," whatever else, can speak for themselves. Significantly, they have been natural leaders in the move to "a metric America" to date. No, my allusion to "freedom" is an internal one . . . that in our respective countries, all trades, in all circumstances, will talk a common measurement language. If that

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[8]Two talks on measurement standards and metric conversion, written for presentation on Radio Belize, may be of interest. Accordingly, texts have been deposited with ERIC. See "Rice by Weight, Other Products by Bulk, and Snared Iguanas at So Much per One," and "For Canadians Today as for Belizeans Tomorrow, 'Metric' Promises a Sounder, Simpler World," Belize City, Belize, January-February 1977.

[9]The EEC, of course, has served notice as to deadlines after which stipulated imports must meet metric specifications.

day does arrive--and, later or sooner, I'm convinced that it will--that language of measurement will not be other than an evolved SI.

"Voluntarism" is a seductive word, and the notion that metric changeover can and will be accomplished through voluntary consensus is attractive. The related issue is, of course, much more complex. Metric conversion in the United Kingdom has been "voluntary" . . . foundering into its second decade. No one, to my knowledge, has seriously attempted to total the cost to date! Metric conversion in the Republic of South Africa, I am reliably informed, has been largely voluntary.[10] The well-known South African prohibitions . . . importation of dually-calibrated measuring devices; use of other than preferred SI in advertising, verbal or otherwise . . . have constituted a winding-up of processes virtually completed through voluntary consensus, I am informed. South Africa accomplished essentially complete conversion in five years, far surpassing such traditionally "metric" nations as France and Germany in universality of use of SI. The head of South African metrication recently resigned . . . his job completed. Canada has "voluntary" conversion. When I try to tease out what, for us, "voluntary" means, I keep coming back to the Government's not being about to foot the bill! In Ottawa's well-turned phrase, costs of Canada's metric changeover will,

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[10]Andre Nadash, Vice President, U.S. Metric Association, Inc., interviewed in New Orleans, 22 January 1977. Tape recording on deposit, Library, Nova Scotia Teachers College.

in general, "lie where they fall" . . . as, one is quick to add, will benefits. Costs are, of course, one-time; benefits of optimal conversion should be continuing. Consumer groups have been rightly artculate that costs are going to be passed on to the consumer. This would seem axiomatic. More serious, to me, is the general feeling that "metric" could become the scapegoat--that "routine" price increases, hardly negligible in these inflationary times, will be attributed to the fact that a product has "gone metric." Long-term savings that could and should result from efficiencies (of product sizes and such) . . . consumers seem less than convinced that such economies are to be passed on!

Leadership, we all know, is going to be crucial for optimal conversion . . . and, in whatever the context, it will need to come from the top. Yet, "metric," in itself, doesn't win votes . . . <u>opposing it</u> just might! Conversion needs to be a high government priority, with the public well aware of the reasons and of the benefits to accrue. Whether we're talking about a president, a state governor, a plant superintendent, or an elementary school principal, what is essential is top commitment coupled with effective feedback at all levels. This is not news. But I think it needs to be said.

Cost, in terms of dollars, in terms of mental energy--that's what it all boils down to, sentimental considerations aside . . . who pays the cost! Assume that we understand that SI conversion is highly desirable (indeed,

inevitable), and that necessary cost is justified, with no elemert of doubt. Who pays the cost? Ultimately, we all do, whether through prices or taxes . . . that's politics. Which way you want it, you'll have to decide. The benefits can and should far outweigh (and outlast) the costs. When do we do all this? The more rapidly, the more efficiently, the better, I strongly suspect . . . although there are sectors where "lead time" clearly is of the essence. I once watched an economist draw a livid picture--a line graph. Two curves, one plotting the unit cost of a conventional component; the other, the cost of its metric counterpart. As those curves cross, a sector goes metric, have no doubt about it. When sheer volume needed for world markets or new metric models brings down the metric unit cost, there's no room for sentimental attachment to old specifications. And in many industries, I gather, that time is fast approaching.

Now is the time, I think we all recognize, to lay foundations for an SI tomorrow. Of those assembled here this morning, some will be privileged to make a continuing contribution at national level. Others will function in their home states, communities, specific industries, classrooms, or shop . . . but where good work is being done, word does get around. If this <u>is</u> the time to start, start with yourself. Bone up on SI . . . this is essential. Then learn to apply the units and structure of SI to situations of the real world . . . road distances in <u>kilometres</u>,

building lot dimensions in metres, waist measures in centimetres, paper sizes in millimetres . . . "weights" in kilograms, grams, and metric tons (tonnes) . . . capacities (commonly) in litres and millilitres . . . atmospheric pressures in kilopascals. You immerse yourself (it takes a bit of doing) . . . you learn, and surprisingly quickly. No Canadian who didn't cheat was having trouble with degrees Celsius after one year . . . after living through and experiencing all our climatic variations without reference to a Fahrenheit thermometer.[11] You quickly find out that "dual labelling" in any form . . . pounds and kilograms on the bathroom scale . . . is worse than useless . . . you never can free yourself from "old" thought patterns, and the "metric" somehow comes through as annoying and awkward. "Hard conversion" (so-called), to well chosen "metric" sizes, is a sure sign that there has been genuine progress.

The real challenge of SI conversion at this point is to "sell" it well and to do it well . . . in terms of short- and long-range benefits, for ourselves and for those who will follow us.

Let me, in summary, therefore, urge strong leadership (at all levels), a clear sense of purpose, and acknowledgement of the central importance of the long-term goal . . .

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[11] "Say Goodnight to Fahrenheit," read the Metric Commission advertisement as degrees Celsius temperature readings officially came to Canada on 1 April 1975. Conversion was to be "cold turkey" . . . to "Celsius only." Cooperation of the press and broadcast media--clearly essential to optimal conversion--has been generally good.

an SI America, working with an increasingly SI world.

Little has been said in these pages that you'll not have heard before. What has been attempted, I hope with some success, has been to identify areas that need your close attention . . . now, and over the increasingly metric years that lie ahead. The rest is up to you . . . and, believe me, I wish you well.